Materials & Chemicals

Improved Immiscible Alloy Formation with Stabilizing Nanoparticles

View U.S. Patent No. 10,036,084 in PDF format.

WARF: P120305US01

Inventors: Xiaochun Li, Lianyi Chen, Jiaquan Xu

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method utilizing nanoparticles to control the growth and dispersion of minority phase droplets in immiscible alloys.

Overview

Immiscible alloys are composed of materials that meld together above a certain temperature but become unstable and separate as the solution cools. For example, elements like bismuth or tin may coagulate into particles that grow and sink to the bottom of a solidifying aluminum-based alloy. The uneven distribution of such droplets can result in poor material properties and limit promising applications like semiconductors and self-lubricating bearings.

The alloy component that separates into droplets is termed the 'minority phase' because it takes up a smaller weight percent of the solution than the 'majority phase' material. A new technique that better restricts the growth and dispersion of minority phase particles could lead to dramatically improved alloys.

The Invention

UW–Madison researchers have developed a method for controlling the size of minority phase droplets during alloy formation. The approach utilizes nanoparticles to rapidly restrict the growth of the droplets after they nucleate and to inhibit coagulation when they collide, allowing for a more uniform mixture.

The nanoparticles are made of a thermally stable ceramic or other material, and are added to the hot liquid alloy solution. Only then is the melt allowed to cool, with the nanoparticles spontaneously assembling between the growing droplets and the rest of the material. In this way, the nanoparticles act as a thin coating around the droplets to prevent them from growing, coalescing and sinking.

Applications

- Immiscible alloy casting
- Manufacturing of bearings, giant magnetoresistive (GMR) materials, superconductors and power electronic switches

Key Benefits

- Highly uniform droplet distribution
- Controls droplet growth and sedimentation (with droplet size down to μm, even nm scale)
- Method can be carried out at cooling rates much lower than those used in rapid cooling techniques.
- Unlike microparticles, nanoparticles usually enhance, rather than deteriorate, alloy properties.

Additional Information

For More Information About the Inventors

- Lianyi Chen

Related Technologies

- For more information about incorporating and uniformly dispersing nanoparticles into metal-based materials, see WARF reference number P120090US01.

Related Intellectual Property

- View Divisional Patent in PDF format.

Tech Fields

- Materials & Chemicals : Composites
- Materials & Chemicals : Metals

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867